CLAIMS

I claim:

1. A method for enhancing vision in an animal under conditions of low intensity light comprising delivering up-conversion materials to the eye of the animal, wherein the up-conversion materials absorb infrared light, and
wherein the up-conversation materials luminescence in the visible range of the electromagnetic spectrum.

2. A method according to claim 1, further comprising exposing the eye of the animal to a source of light of a wavelength sufficient to excite the up-conversion materials.

3. A method according to claim 1, wherein the up-conversion materials comprise one or more lanthanoid ions.

4. A method according to claim 1, wherein the up-conversion materials comprise a semiconductor with a band gap in the infrared.

5. A method according to claim 3, wherein the lanthanoid ion is selected from the group consisting of Pr, Nd, Eu, Er, Gd, and Yb.

6. A method according to claim 5, wherein the lanthanoid ion comprises Er.

7. A method according to claim 1, wherein the up-conversion materials are in the form of nanoparticles.

8. A method according to claim 7, wherein the nanoparticles comprise SiO_2.

9. A method according to claim 7, wherein the nanoparticles comprise CdSe.

10. A method according to claim 1, wherein the up-conversion materials comprise a lanthanoid ion in a glass.

11. A method according to claim 7, wherein the nanoparticles are covalently bound to an antibody, wherein the antibody is specific for an antigen on a protein component of the eye.

12. A method according to claim 11, wherein the antibody is an antibody specific for a rod protein.

13. A method according to claim 11, wherein the antibody is specific for a cone protein.

14. A method according to claim 11, wherein the antibody is specific for ROM-1.

15. A method according to claim 11, wherein the antibody is specific for peripherin.

16. A method according to claim 11, wherein the antibody is specific for arrestin.

17. A method according to claim 11, wherein the antibody is specific for rhodopsin.

18. A method according to claim 1, wherein delivering the up-conversion material to the eye is carried out with iontophoresis.

19. A method according to claim 1, wherein the animal is a human.

20. A method according to claim 1, wherein the animal is non-human.

21. A composition comprising a nanoparticle covalently bound to an antibody, wherein the nanoparticle comprises an up-conversion material that absorbs electromagnetic radiation having a wavelength greater than about 650 nm and luminesces in the visible region of the electromagnetic spectrum, and the antibody is an antibody specific to a protein component of the eye.

22. A composition according to claim 21, wherein the antibody is specific to an antigen selected from the group consisting of rod proteins, cone proteins, ROM-1, peripherin, arrestin, S-antigen, and rhodopsin.

23. A composition according to claim 21, wherein the up-conversion material comprises one or more lanthanoid ions.

24. A composition according to claim 21, wherein the up-conversion material comprises a semiconductor having a band gap in the infrared.

25. A composition according to claim 21, wherein the nanoparticles comprise SiO_2.

26. A composition according to claim 21, wherein the nanoparticles comprise an organic polymer.

27. A composition according to claim 21, wherein the antibody is an antibody specific to peripherin.

28. A composition according to claim 21, wherein the antibody is an antibody specific to ROM-1.

29. An animal having enhanced vision, wherein an up-conversion material is optically coupled to the photoreceptors of at least one eye of the animal.

30. An animal according to claim 29, wherein the up-conversion of the material comprises nanoparticles comprising a material that absorbs infrared and luminesces visible light.

31. An animal according to claim 29, wherein the up-conversion material comprises one or more lanthanoid ions.

32. An animal according to claim 29, wherein the up-conversion material comprises two or more different lanthanoid ions.

33. An animal according to claim 29, wherein the up-conversion material comprises a semiconductor material having a band gap in the infrared.

34. An animal according to claim 29, wherein the up-conversion material is bound to an antibody that preferentially binds to a portion of one of the biomaterials in the eye.

35. An animal according to claim 34, wherein the antibody is an antibody to a rod protein.

36. An animal according to claim 34, wherein the antibody is an antibody to a cone protein.

37. An animal according to claim 34, wherein the antibody is an antibody to ROM-1.

38. An animal according to claim 34, wherein the antibody is an antibody to peripherin.

39. An animal according to claim 34, wherein the antibody is an antibody to X-arrestin.

40. An animal according to claim 34, wherein the antibody is an antibody to S-antigen.

41. An animal according to claim 34, wherein the antibody is an antibody to rhodopsin.

42. An animal according to claim 29, wherein the up-conversion material is optically coupled to two eyes of the animal.

43. A dog according to claim 29.

44. A method for visualizing an object under conditions of low ambient light comprising:

exposing the object to incident electromagnetic radiation having a wavelength greater than what can be seen by the naked eye; and

perceiving light reflected from the object with an enhanced eye,

wherein the enhanced eye comprises an up-conversion material optically coupled to the photoreceptors of the eye,

wherein the up-conversion material absorbs light of the wavelength reflected from the object, and luminesces in the visible region of the electromagnetic spectrum.

45. A method according to claim 44, wherein the up-conversion material comprises one or more lanthanoid ions.

46. A method according to claim 44, wherein the up-conversion material comprises two or more different lanthanoid ions.

47. A method according to claim 44, wherein the up-conversion material comprises a semiconductor having a band gap in the infrared.

48. A method according to claim 44, wherein the up-conversion material is in the form of a nanoparticle covalently bound to an antibody, wherein the antibody is specific for an antigen in a biomaterial found in the eye.

49. A method according to claim 48, wherein the antibody is an antibody to a rod protein.

50. A method according to claim 48, wherein the antibody is an antibody to a cone protein.

51. A method according to claim 48, wherein the antibody is an antibody to ROM-1.

52. A method according to claim 48, wherein the antibody is an antibody to peripherin.

53. A method according to claim 48, wherein the antibody is an antibody to S-antigen.

54. A method according to claim 48, wherein the antibody is an antibody to X-arrestin.

55. A method according to claim 44, wherein the incident electromagnetic radiation is light of a single frequency.

56. A method according to claim 44, wherein the incident electromagnetic radiation is coherent laser light.

57. A method according to claim 55, wherein the source of the light is a light emitting diode.

58. A method according to claim 44, wherein the object is continuously illuminated.

59. A method according to claim 44, wherein the object is illuminated by a source of non-classical light.

60. A method according to claim 44, further comprising providing a source of photons separate from the light reflected from the object, wherein the photons excite the up-conversion materials.

61. A method for visualizing an object with an enhanced eye, wherein the enhanced eye comprises an up-conversion material optically coupled to the photoreceptors of the eye, comprising

providing the eye with a first source of photons that sensitize the up-conversion material; and

providing the eye with a second source of photons reflected from the object, wherein the up-conversion material absorbs the light reflected from the object and luminesces in the visible.

62. A method according to claim 61, wherein the first source of photons is delivered to the eye without reflecting off the object.

63. A method according to claim 61, wherein the first source of photons has a wavelength of 1000 nm or less.

64. A method according to claim 61, wherein the second source of photons has a wavelength of 1500 nm or greater.

65. A method according to claim 61, wherein the second source of photons is from a CO_2 laser.

66. A method according to claim 61, wherein the first source of photons is provided by a light emitting diode.

67. A method according to claim 61, wherein the up-conversion material is in the form of nanoparticles.

68. A method according to claim 67, wherein the nanoparticle is covalently bound to an antibody for a protein component of the eye.

69. A method according to claim 67, wherein the antibody is an antibody specific for ROM-1 or peripherin.